Fairbanks Fishery Resources Project Report Number FY-86/8

PROGRESS REPORT
RECONNISANCE SURVEY OF THE SUBSISTENCE/COMMERCIAL WHITEFISH, NORTHERN PIKE, AND BURBOT FISHERY IN THE VILLAGE OF SELAWIK WITH EMPHASIS ON DEVELOPING METHODS TO MONITOR ITS EFFECT ON THE EXPLOITED STOCKS

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June 22, 1986

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ABSTRACT

Observations of the spring subsistence/commercial whitefish northern pike and burbot fishery in the Village of Selawik was iniated during the month of June, 1985. Preliminary conversations with local fishermen and Alaska Department of Fish and Game biologist indicated the fishery occurs during spring and fall when fish drying conditions are optimal. Observations were made by boat and aircraft. Distribution of fish camps, composition of catch, gear types and time intervals fished were noted. Species harvested included broad whitefish Coregonus nasus, humpback whitefish Coregonus pidschian, least cisco Coregonus sardinella, and northern pike Esox lucius. Burbot were not harvested in the spring fishery. Conversations with fishermen indicated burbot is typically harvested in the fall.

A method of stratified random sampling with a roving creel is suggested for estimating total harvest and fishing effort. Use of catch curve , cohort analysis, changes in fishing effort, and yield per hectare are suggested as methods for monitoring the exploited whitefish and northern pike stocks.

An effort to tag spawning humpback and broad whitefish from August 22nd to September 15th, 1985 on the spawning grounds of the upper Selawik River was largely unsuccessful due to high flows. In total, 55 humpback whitefish were tagged with an average length of 377 mm and estimated age of 8 to 11 years.

Ageing of whitefish was found to be difficult. Scales were aged by two people with the resulting percent agreement: Broad whitefish 20%, humpback whitefish 12%, and least cisco 35.5%. It is suggested that other ageing techniques be used, such as, otoliths or fin rays in future investigations.

INTRODUCTION

A reconnisance survey of the harvest of the mixed stocks of whitefish, (broad whitefish (BWF) Coregonus nasus, humpback whitefish (HWF) Coregonus pidschian, least cisco (LCI) Coregonus sardinella, northern pike (NOP) Esox lucius, and burbot (BB) Lota lota in the Selawik River drainage is necessary because of a subsistence and commercial fishery exploiting these stocks. Management of the fishery is a responsibility of the U.S. Fish and Wildlife Service due to the utilization of these fish species as a subsistence food item, and as a resource of the Selawik National Wildlife Refuge.

Existing management techniques for commercial fisheries require knowledge of life histories of the exploited stocks, tend to be expensive, are labor intensive, and require active participation of the fishermen. Because of a lack of life history information, small size of the fishery, and it's "bush" setting, monitoring methods need to be developed that can be performed inexpensively, simply, and with minimal participation of the fishermen, while possessing tested precision and accuracy.

Development of the Commercial Fishery

To increase cash income of local fishermen, and to utilize what is perceived to be an abundant fishery resource, the Village of Selawik obtained a $200,000 grant in 1984 from the Administration for Native Americans to study the feasibility of developing a commercial fish mincing plant. Rural Ventures, an Anchorage based firm, conducted the study and found that it was impossible for the village to meet Department of Environmental Conservation requirements for a mincing plant and that a dried or naturally fresh frozen product would be more suitable. The village asked the Alaska Department of Fish and Game (ADF&G) to issue a permit to harvest 250,000 pounds of whitefish, (all species except sheefish which are included under a separate commercial permit), but the permit was denied because little information exists on the whitefish stocks. Instead the ADF&G issued a permit for a conservative harvest of 5,000 pounds whitefish and 1000 pounds each of northern pike and burbot. At that point the village asked the Selawik NWR assist in obtaining information needed to determine the impact of increased harvest.

In 1985 the village was issued a new permit by ADF&G for 15,000 pounds of whitefish and 3,000 pounds each of northern pike and burbot. The permit allowed commercial fishing to occur from June 1, 1985 to December 31, 1985 within a radius of 15 miles from the village (Figure 1). Another grant was obtained from the Administration for Native Americans to market dried fish and other fresh fish products. The final dried product was not sold in the traditional fish string form, but broken into pieces and packaged in styrofoam meat trays covered with cellophane. The finished product sold for $12.00 per tray for northern pike and $13.00 per tray for whitefish. A tray had approximately 6 dried northern pike or 8 dried whitefish. Trays weighed approximately 1 1/2 pounds each (Luke Sampson, pers. comm.). Most of the fish were sold in Kotzebue during the summer.

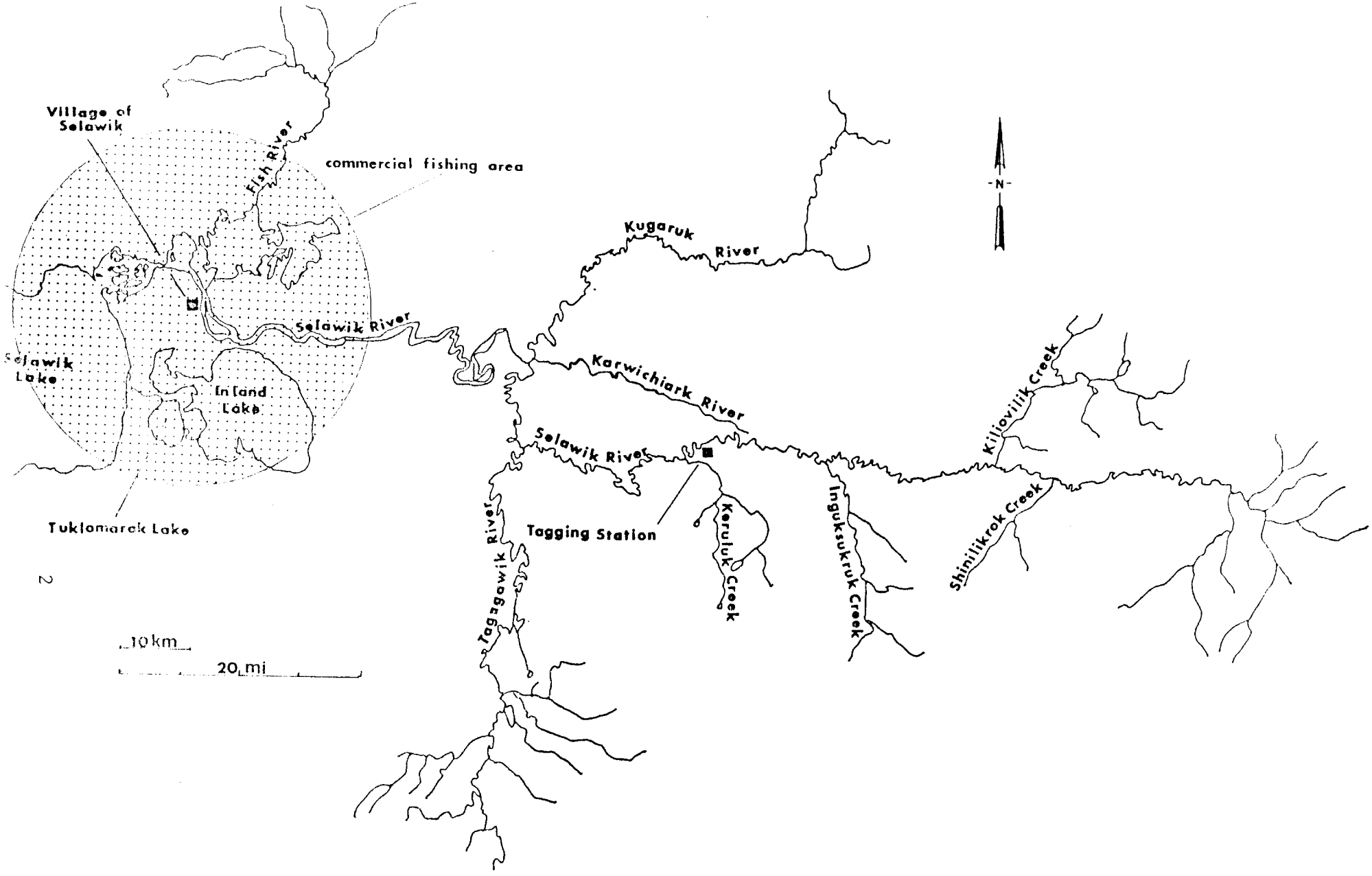


Figure 1.--Permit area for commercial fishing of whitefish, northern pike, and burbot within a fifteen mile radius of the Village of Selawik. Included on this map are tributaries of the Selawik River, the Kugaruk and Tagagawik Rivers, and the location of the fall tagging station.

Current Management of the Fishery

The ADF&G has increased quotas on a gradual bases in hopes of detecting adverse effects on the stocks in question and then adjusting harvests accordingly. Studies of the whitefish stocks were proposed in 1985 by the ADF&G but funding was not provided. It was at this point that the Selawik NWR requested the assistence of the Fairbanks Fisheries Resources office to conduct these studies.

The Subsistence Fishery

The Final Environmental Impact Statement (FEIS) prepared by the Department of Interior for the Selawik NWR estimated in 1974 a total subsistence harvest of 807,643 pounds of whitefish, 143,312 pounds char/pike, and 22,303 pounds of burbot for the Selawik socio-economic area. Alt (1972) noted 27 families subsistence fishing in 1972 from the Selawik area plus 4 families from Noorvik and Kiana.

Fish Species of the Subsistence/Commercial Fishery

Humpback whitefish of Northwestern Alaskan coastal streams have tentatively been identified as Coregonus pidschian of the C. clupeaformis complex, Alt (1974) and McPhail and Lindsey (1970), a variety described as being truly anadromous by Morrow (1980). Spawning movements and length at age information from humpback whitefish of the Selawik River as well as other Alaskan streams has been detailed by Alt (1980). Length and age data for broad whitefish from the Yukon, Kuskokwim, Imuruk and Sagavanirktok River drainages has been documented by Alt (1976). Length at age and distribution information of humpback and broad whitefish, least cisco, northern pike, and burbot from the north coastal plain has been documented by Bendock and Burr (1984), Bendock (1982), Alt and Kogl (1973). and Roguski, Komarek and Kogl (1971). The most comprehensive work of interior Alaskan burbot has been done by Chen (1969).

As has been noted, the variety of humpback whitefish Coregonus pidschian that exists in the Selawik River drainage is thought to be anadromous. Alt (1979) indicated that Kobuk River humpbacks overwinter in the Hotham Inlet which is next to Selawik Lake (Figure 2). Alt (1977) has additionally indicated that the Kobuk River and Selawik River sheefish Stenodus leucichthys constitute a single population and that the lower Selawik River slough and lake system is an important feeding area for sheefish spawning in the upper Kobuk River. The close proximity of the Selawik River to the Kobuk River and the possibility that the whitefish species might share common overwintering and feeding areas indicate the possibility that several stocks might be using the Selawik River delta for summer feeding. The Selawik River has two large tributaries, the Tagagawik and Kugaruk Rivers. Any whitefish species utilizing these separate drainages for spawning might be treated as a separate stock for management purposes.

No data of exploited broad whitefish, humpback whitefish, and least cisco populations has been located, however, much information exists on exploited lake whitefish populations. An examination of exploited lake whitefish populations in the Northwest Territories, Canada was done by Healy (1975). Information on exploited northern pike populations in Ontario, Canada has been documented by Adams and Olver (1977).

Objectives

Our objectives for the 1985 study season were:

1) Gain background information on the nature of the subsistence/commercial fishery, such as: gear descriptions, fishery timing, areas fished, locations of camps, fishing effort, species composition, and age, length, and weight of the exploited species.

2) Gain backround information on a major spawning stream, the Selawik River, including: run timing, species composition, and age, length, and weight relationships.

3) Tag species of concern on the spawning grounds of the upper Selawik River to document movements, and exploitation in the fishery in following years.

Description of the Study Area and the Selawik River Drainage

Observations of the subsistence fishery took place within a 15 mile radius of the Village of Selawik. A tagging station was located 117 miles upstream from the Village of Selawik on the Selawik River, (Figure 1).

The Selawik River drainage is located in Northwestern Alaska. The Noatak, Kobuk, and Selawik rivers nearly joined at their mouths in recent geological time, gradually forming separate deltas consisting of numerous lakes, swamps, and sloughs, forming the lowlands which extend to an elevation of approximately 200 feet. Boreal forest is the dominant vegitative type at lower elevation, while tundra dominates in the upper elevation.

All rivers in the Selawik drainage are nonglacial in origin. The Selawik River, the upper 120 miles of which is designated a wild and scenic river, drains out of the northern slopes of the Purcell mountains, and Selawik Hills, and the southern slopes of the Zane Hills, Sheklukshuk Range, and the Waring Mountains. The Selawik river has a low gradient of 3% for the upper 70 miles, and .07% for the lower 120 miles. Highest elevation in the upper watershed is approximately 1600 feet.

Important tributaries of the Selawik River are the Tagagawik River, which is spring fed and drains out of the Selawik Hills and Purcell mountains; the Kugaruk River, which drains out of the Waring mountains and Shekluksuk Range; and the Fish River which drains out of the Waring mountains.

Little weather information exists for the Selawik vicinity, however, the area is described as having a continental climate characterized by large seasonal variations in temperature and precipitation (temperatures range from +90° F to -60°F). Average annual precipitation 15 to 20 inches in the lower elevations and 25 to 30 inches in the higher elevations. Highest rainfall occurs in July, August, and September when the area receives as much as 3 inches per month.

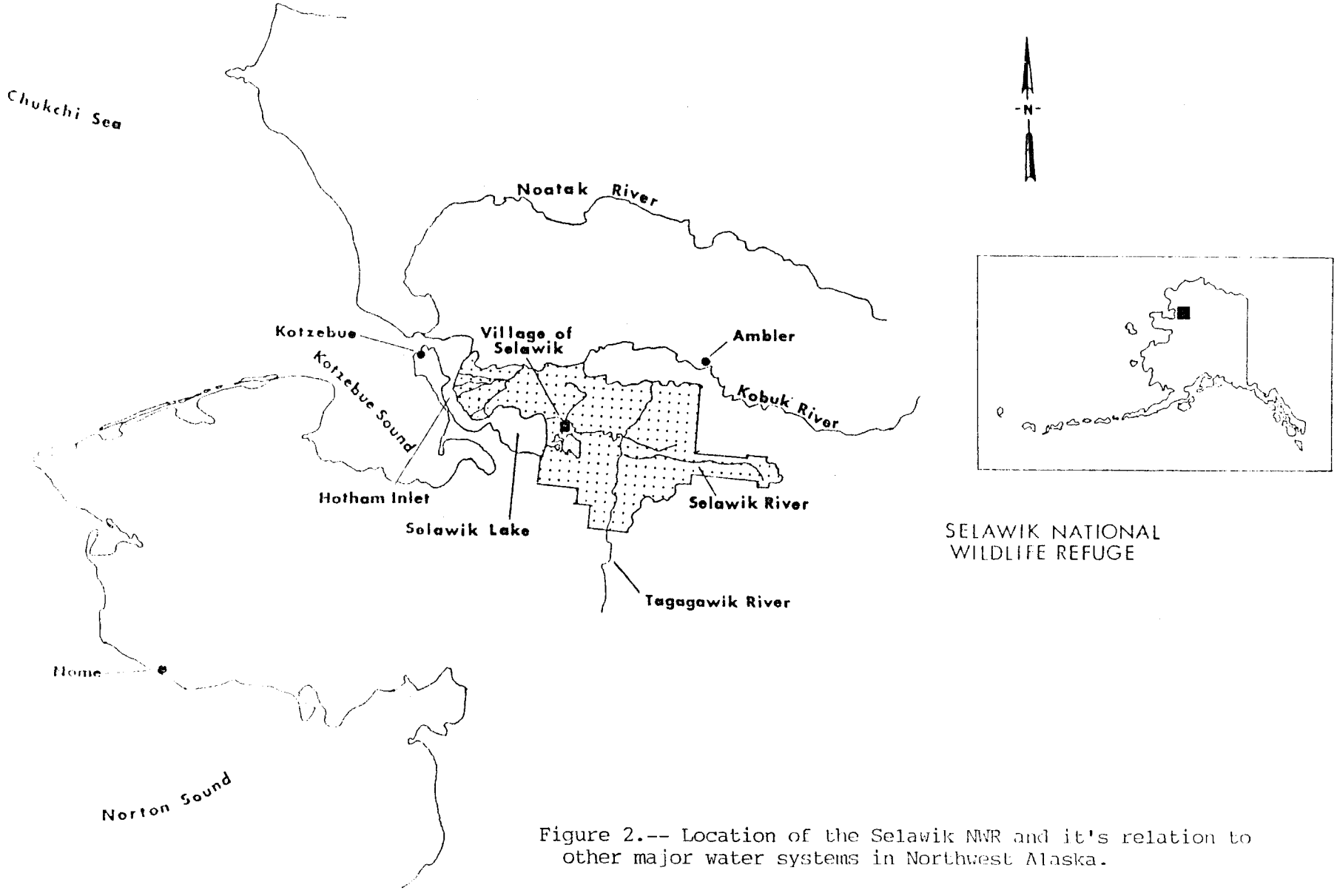


Figure 2.-- Location of the Selawik NWR and it's relation to other major water systems in Northwest Alaska.

The Village of Selawik is located 70 miles East of Kotzebue and 3 Miles North of the Arctic Circle and has an elevation of less than 100 feet. Henning, Olds, Morgan and Rennik (1981) indicated a population of 580 in the Village of Selawik.

A detailed physical description of the Selawik River drainage is provided in the FEIS for the Selawik NWR published in 1974 by the Department of the Interior.

MATERIALS AND METHODS

Spring Sampling Stations

Experimental gillnets were used to expand the size range of fishes sampled. Sampling stations were picked subjectively to cover a broad spectrum of habitat types within the area where subsistence/commercial fishing takes place (Figure 3). Sampling was accomplished using 125 foot experimental gillnets which consisted of 5, 25 foot panels with bar mesh sizes of 3/4 to 2 1/2 inches. The nets were fished from 2 to 24 hours per day depending on the time available, from June 15th until June 27th, 1985 to coencide with subsistence/commercial fishing activities. Sampling also occrrued during the first two weeks of September, which was just prior to subsistence fishing activities.

Spring Subsistence/Commercial Fishery

Distribution and number of fish camps was determined by boat with the assistance of a local female resident who spoke Inupiate, facilitating interviews with fishermen. Camps were also located from the air. During the flight all observable fishing related objects, such as boats, nets, drying racks, and floats were noted. The number of people commuting to fishing areas from the village (those who do not set up formal camps) was estimated by counting drying racks in the village.

In order to sample the compostion of the subsistence catch, arrangements were made to pick the nets for the fishermen. This ensured that the fishermen would not process the catch before our arrival. While in the camps numbers of nets, mesh sizes, different fishing locations for nets, estimated length of nets, time the nets were fished, species composition, numbers of fish caught, and age, length, and weight of the fish caught were documented.

Age, Length, and Weight

Captured fish were measured for fork length. Weights in grams were obtained from the first 10 individuals in each 50 mm size class for whitefish species and each 100 mm size class for northern pike. Only lengths were taken from subsequently captured fish from each size class.

Ages were derived from scales of whitefish using techniques as described by Jearld (1983). Ageing of northern pike was accomplished using cliethra as described by Harrison and Hadley (1979). Scales were read directly by two individuals using a 3M model 800 microfiche reader. Those scales in which the two ageings differed more than two years were not used for length at age estimates. Percent agreement was determined from the number of fish aged of a given species where the two readers were in agreement, divided by the total number of fish aged.

Length/weight regressions were computed for fish harvested in the fishery using the form $\log_{10}$ weight = a + b $\log_{10}$ length.

Condition factor (K) was determined using the following formula:

$$K = (\text{Weight in Grams}) \times 10^5 / (\text{Length in Millimeters})^3$$

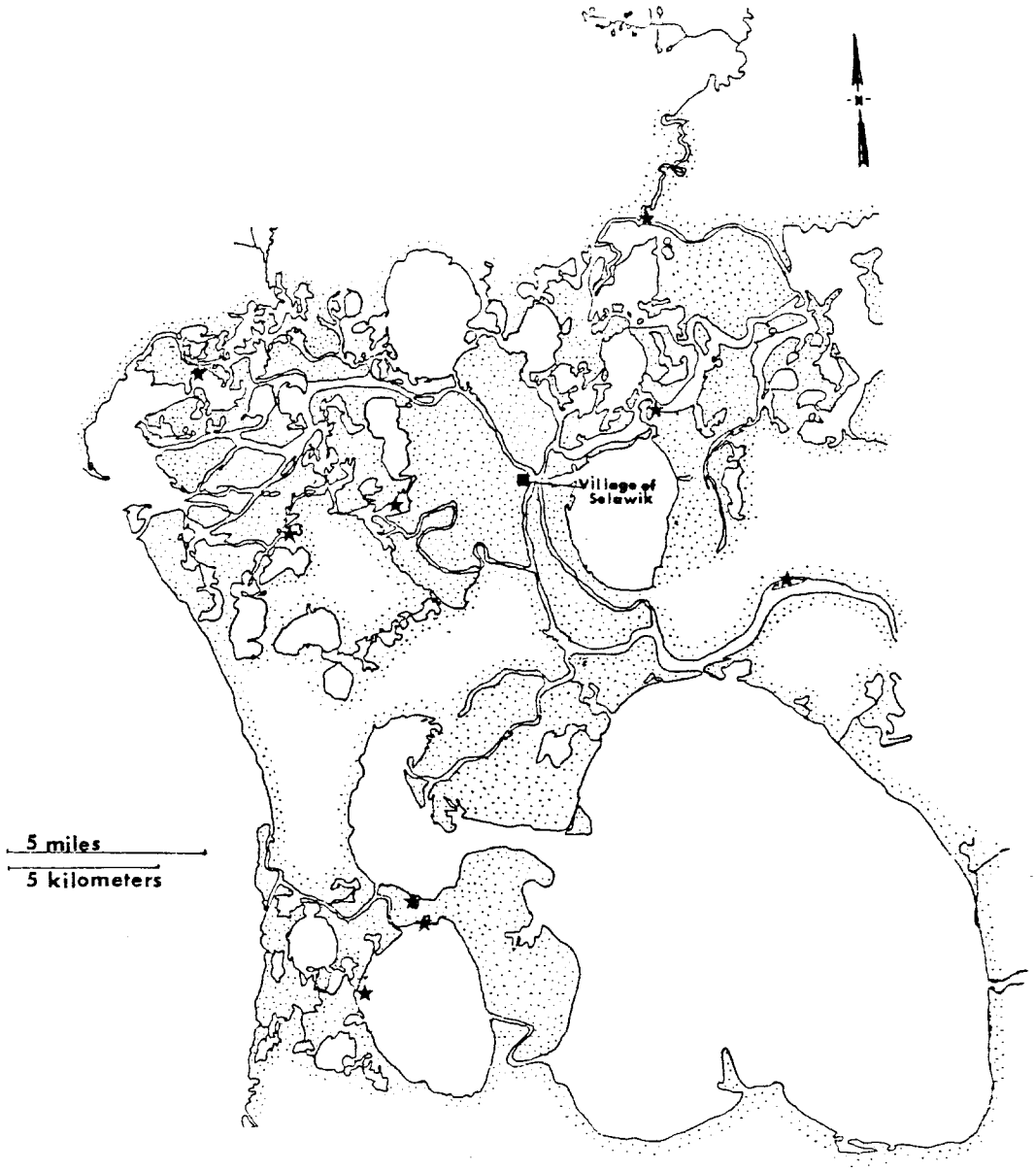


Figure 3.--Sampling stations within the commercial fishing area of the Selawik NWR.

Fall Subsistence/Commercial Fishery

From September 4th until September 15th the fall subsistence/commercial fishery was sampled in the same manner as described for the spring fishery.

Fall Tagging, Selawik River

A tagging station was established on the upper Selawik River 117 miles upstream from Selawik Village between Keruluk and Ingruksukruk Creeks from August 22th until September 14th (Figure 1). The camp was established at this location in the belief that it was located just below the whitefish of spawning grounds (Alt, pers. comm.).

Fish were collected using a 75-foot experimental gillnet with three panels having bar mesh sizes of 1, 1-1/2, and 2-inches, and a framed hoop net with a 3 by 6-foot opening and 1/2-inch mesh and an 8 inch throat diameter.

Fish in good condition were tagged using 13-inch yellow spaghetti tags made by Floy Tag and Manufacturing, Seattle, Washington. Tags were printed with a five digit number and the address of the Selawik NWR. Tags were inserted through pterysiophores below the posterior 1/3 of the dorsal fin using a hollow 2 mm. diameter stainless steel needle. One end of the tag is inserted into the hollow needle and then drawn through the musculature. Both ends of the tag were then brought together directly behind the dorsal fin and tied with an overhand knot, making sure that it did not interfere with the dorsal fin.

Flyers were posted in public buildings in the Village to alert fisherman to the tags and direct them to mail the tags to the Refuge office (See Appendix pg. 27). Included with the flyers were postage paid envelopes addressed to the Refuge office with a questionaire asking for information on when, where, and how the fish were caught. Fishermen were alerted during spring subsistence sampling that we would be introducing tagged fish to the river.

Estimation of Total Spring Harvest

Total harvest for the subsistence/commercial spring fishery was estimated using the following formula:

$$\text{Total Harvest} = \underset{\text{(net-hrs./season)}}{\text{Total Seasons Effort}} \times \underset{\text{(catch/net-hr.)}}{\text{Mean Catch Rate}}$$

$$\text{Total Season Effort} = \text{Net-Hrs./Day/Fisherman} \times \text{Total No. of Fishermen} \times \text{Total No. of Days/Season}$$

$$\text{Mean Catch Rate} = \text{Catch/Hr./100 foot of Net} \times \text{Mean Net Length/Fishermen}$$

A fisherman is defined as a distinct fish processing group, (usually a family), fishing in a specific area or areas. A communting fisherman is a fisherman who lacks a formal fishing camp and who commutes to a fishing area or areas from the village. Some fishermen were sampled on more than one date, and at more than one area. A fisherman sampled on a specific day and at a spcific area is defined as being sampled on a specific fisher date-area. Mean net-hrs./day/fishermen was determined from the mean number of hours fished per day per net from the sampled fishermen. Total numbers of fishermen, (minimum and maximum numbers), was estimated from counts made from a boat, counting drying racks in the village, or by counting camps from an aircraft. The minimum number of fishermen was determined from actual numbers of fish camps and fishing areas of commuting fishermen documented. Maximum numbers of fishermen was estimated from the minimum number of fishermen plus the number of drying racks counted in the village to estimate additional commuting fishermen. The total number of days/season was determined from the date of breakup to the date when drying conditions deteriorate and fishing ceases. Catch/hour/100 foot of net was determined from the total catch by species divided by the total number of hours fished among all the sampled fishermen divided by the total feet of nets fished multiplied by 100. Mean length of nets was determined from the total length of nets from all sampled fishermen divided by the total number of nets observed.

Total harvest by weight was calculated by multiplying mean weight (gms) times the total number of fish harvested. Commercial harvest was determined from fish tickets filled out by the village at the time of a commercial sale, a requirement of the ADF&G. Total subsistence harvest was determined by subtracting commercial harvest from total harvest.

RESULTS AND DISCUSSION

Ageing Studies

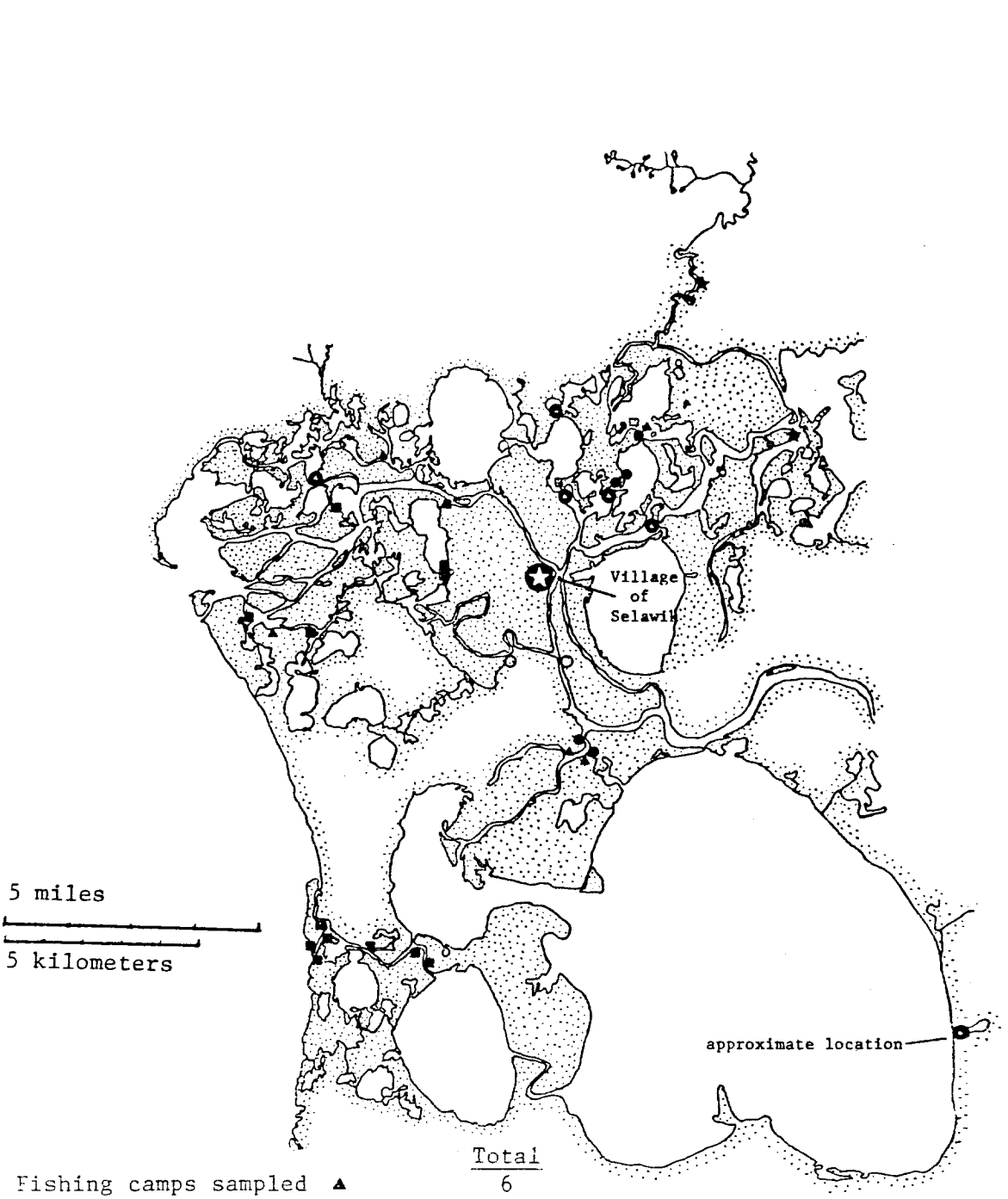
The percent agreement between the two readers for broad whitefish was 20%; for humpback whitefish 12%; and for least cisco 35%. It was agreed by those individuals reading these scales that different ageing techniques should be investigated in the future. Fin rays, otoliths, or even cliethra may yield more consistent results. It would be possible to use otoliths for fish collected outside the fishery but the mangling of the fish heads would make this technique unsuitable within the subsistence/commercial fishery.

Length at age is documented in Appendix Table 3 for broad whitefish, humpback whitefish, least cisco, and northern pike. Average length and age of broad whitefish caught in the subsistence/commercial fishery was approximately 427 mm and 10 to 11 years of age, humpback whitefish was 405 mm and approximately 11 to 12 years of age, least cisco was approximately 330 mm and 6 to 9 years of age, for northern pike was 650 mm and approximately 11 to 12 years of age.

Spring Subsistence/Commercial Fishery

The seasonal timing of the fishery producing dried fish is dictated by weather. Most important is breakup which marks the beginning of the spring fishery. Breakup can vary as much as 30 days, occuring as early as mid-May or as late as mid-June. When proper drying conditions do not exist the production of dried fish ceases. Proper drying conditions consist of cool, dry, breezy days of the type normally associated with spring. In 1985 the spring fishery extended from approximately June 7th until July 4th.

Most spring fishing occurs in sloughs connecting the main river channel with shallow lakes. Observations suggest that northern pike move from overwintering areas to shallow lakes to spawn via these sloughs. Northern pike captured in these sloughs in June had ripe eggs. All the observed camps are located well within a fifteen mile radius of the Village of Selawik as stipulated in the commercial fishing permit. An estimated minimum number of 18 active subsistence fishermen determined from actual observations of 12 active fish camps and 6 commuting fishermen. It is estimated that there is a possible maximum of 29 subsistence fishermen. This is derived by counting 11 fish drying racks in the village to estimate the number of commuting fishermen that had not been sampled or observed. In 1972 it was estimated that a total of 31 fishermen participated in the fishery, 27 from the Village of Selawik and 4 from Noorvik and Kiana (Alt 1972). Thirteen abandoned camps were also noted, (Figure 4). It should be noted that the fishing effort of the commuting fishermen was documented in only 2 cases, whereas half of the known fishing camps (6) were sampled, and that level of effort by fishermen that commute and those that set up formal camps could be quite different.



	Total
Fishing camps sampled ▲	6
Active camps not sampled ◆	6
Net locations sampled for fishers fishing out of the village ●	4
Net locations not sampled for fishers fishing out of the village ○	2
Fall fishing camps ★	2
Derelict camps ■	13

Figure 4.--Location of active and abandoned subsistence/commercial fishing camps observed during the spring and fall of 1985.

The catch of eight fishermen were sampled on a total of fifteen different fisher date-areas. Of the fifteen fisher date-areas, 24 nets were sampled having a mean length of 79 feet and a length range of 30 to 200 feet. Gear types appeared to be uniform among the fishing camps, using various lengths of 2 inch bar mesh multifilament gillnet. Only one fisherman was interviewed using 1 1/2 inch bar mesh net and that was changed because the fisherman was disappointed in the size of the fish she was catching. Net length varied with the area fished; a camp near a wide slough might fish one long continuous net, whereas a camp located on a narrow slough might fish several nets parallel to each other across the slough. Mean number of hours fished per fisher date-area was 23 hours. Total number of fish caught among all fisher date-areas was 702 (broad whitefish, humpback whitefish, least cisco, northern pike, and sheefish), having a mean harvest of 47 fish per fisher date-area, and a mean number of fish caught per hour per 100 feet of net of 1.87 fish (S.D. = 1.645). A summary of subsistence/commercial fishing effort and maximum and minimum estimated catch is given in Table 4 and 5 of the Appendix.

Broad whitefish were the most common species caught comprising 41% of the catch, followed by northern pike (38%), and humpback whitefish (19%). Least cisco and sheefish comprised a small portion being 2% and 0.4% of the total, respectively. Fishermen indicated a mixed preference between whitefish (broads and humpbacks) and northern pike, some prefering one or the other with no clear overall preference. It would appear that with only three sheefish observed among the fishermen interviewed that the spring sheefish catch is low.

Total Estimated Harvest for 1985 Spring Subsistence/Commercial Fishery

It is estimated that a minimum of at least 18 active fishermen, and a possible maximum of 29 fishermen participated in the fishery. In addition, 25 days of fishing effort occured from breakup, (approximately June 10th), until warm weather and flying insects ended proper drying conditions (approximately July 4th). It should be noted that harvests of sheefish can be misleading. Conversations with fishermen indicated that one or two individuals targeted on sheefish just after breakup on Inland Lake, and that these fishermen could take as many as 50 sheefish a night over a one to two week period. Hook and line fishing for sheefish is also quite popular in the village which would add to the total harvest of sheefish. Minimum and maximum estimated subsistence/commercial gillnet harvest is given in Table 1.

Table 1. Minimum (based on 18 fishermen) and maximum (based on 29 fishermen) estimated harvest of the 1985 spring subsistence/commercial fishery.

species	MINIMUM ESTIMATED HARVEST number caught	MINIMUM ESTIMATED HARVEST live wt (lbs.)	MAXIMUM ESTIMATED HARVEST number caught	MAXIMUM ESTIMATED HARVEST live wt (lbs.)
BWF	6,852	15,102	13,974	30,800
HWF	3,022	5,848	4,869	9,424
LCI	362	367	584	594
NOP	5,671	30,512	9,138	49,166
SF	52	509	83	813
Totals	15,959	52,338	28,648	90,797

Comparing minimum and maximum estimated harvests of whitefish, there was a range of 21,317 to 40,818 pounds, which is 42% to 172% larger than the maximum allowable commercial harvest of 15,000 pounds. The minimum and maximum estimated harvests of northern pike was 30,512 to 49,166 pounds, which is 917% to 1538% larger than the maximum allowable commercial harvest of 3,000 pounds. The FEIS (1974) documented a total annual subsistence harvest for the year of 1974 at 807,643 pounds of whitefish, and 143,312 pounds char/pike, (the combined harvest in 1974 of char/pike was not explained in the FEIS), indicating a much larger harvest than is currently observed. For instance, the maximum harvest estimate for whitefish of 40,818 pounds, is only 5% of the annual total 807,643 estimated for 1974 in the FEIS. Our conversations with fishermen in the village indicated that char are seldom taken in the fishery.

The final totals for the 1985 commercial harvest are listed in Table 2. The total commercial harvest exceeded the 3,000 pound quota for northern pike (5,772 pounds harvested), but did not approach the 15,000 pound quota for whitefish, (6,938 pounds harvested). The commercial harvest is determined from fish tickets, which are filled out when the fish are sold to the village whitefish project.

Table 2. Total 1985 commercial fish harvest from Selawik fishery (Charles Lean, Alaska Department of Fish and Game, pers. comm.).

species	number caught	mean wt. gms.	mean wt. lbs.	total live wt. kgs.	total live wt. lbs.	value
combined whitefish	2,775	1,135	2.5	3,149	6,938	$5,207
northern pike	1,226	2,134	4.7	2,620	5,772	$2,884
sheefish	89	3,045	6.8	271	607	$603
burbot	81	3,345	7.5	271	607	$516
totals	4,171			6,311	13,924	$9,170

Our observations and conversations with fishermen indicated that northern pike are harvested predominately in the spring, whereas burbot are taken in the fall (no burbot were observed in the spring harvest). Sheefish were seen taken by hook and line in both the spring and the fall. Whitefish were taken both in the spring and the fall fishery.

Fall Subsistence/Commercial Fishery

Efforts to document fall subsistence fishing ran into difficulties with our arrival in the village being too early. Like the spring fishery, activities are dictated by suitable drying conditions. The 1985 fall fishery producing dried fish began around the third week of September and ended with freezeup during the first or second week of October. At this time fishing activities continue, but fish are fresh frozen. There is a shift in some of the fishing camps away from the mouth of Selawik and towards an area north of the village, this may be done in an effort to take advantage of any fall runs on the Fish River, though this was never documented.

Fall Tagging

From August 22nd to September 14th while the tagging station was in operation, only one broad whitefish was captured and no least cisco were observed. Fifty-five humpback whitefish were tagged out of a total of 95 captured. They averaged 377 mm in length and ranged in age from 8 to 11 years. The mean length of humpback whitefish taken in the subsistence fishery was 405 mm in length and ranged in age from 8 to 12 years. Those female humpback whitefish sacrificed at the tagging station appeared to have viable eggs. This would indicate that the subsistence/commercial fishery is targeting on adult humpback whitefish.

Logistics in the fall are difficult. Aircraft in the Kotzebue area change from floats to wheels or skis around mid-September, but a lack of snow or ice can limit their use until late October. Consequently helicopters are the only reliable method of transportation to remote areas. Any tagging effort in the upper watersheds of spawning whitefish would be a costly endeavor, but would yield information on movements, subsistence utilization, and possible population estimates of specific stocks.

The location of the tagging station in the upper Selawik River was the best location available in terms of the capability to land small aircraft on floats in a nearby lake, and when flow conditions are right, an excellent place for sampling. However, high flows and the possibility that we were early for the peak whitefish runs combined to limit the tagging effort. An early run of humpback whitefish was documented as starting in the second week of September, and small numbers of sheefish were observed migrating to spawning areas in late August.

The last week of September through the second week of October might be a better sampling period due to lower flows from the subsequent freezeup of tributary streams, and because of the possibility greater numbers of whitefish migrating to spawning areas.

CONCLUSIONS

Defining Stocks

Methods to monitor the fishery will be dependent on the nature and contributions of the different stocks in this mixed stock fishery. Contributions to the fishery of whitefish stocks from outside the Selawik River drainage, such as from the Kobuk River, could be determined by radio tagging whitefish in the fishing area near the Village of Selawik in July or August and tracking these fish on their spawning migrations. Radio tagging of migrating spawners would be useful for locating concentrations of spawning whitefish on the Selawik, Kugaruk, and Tagagawik Rivers, this would help in finding future tagging stations as well as documenting important spawning areas. Radio tagging of broad whitefish has been done using external transmitters on the Mackenzie River by Chang-Kue and Jessops (1983), they experienced a 50% success rate with their tagging efforts.

Large scale spaghetti tagging of spawners from specific drainages would yield information on the contributions of specific stocks to the fishery as well as document their movements. Spaghetti tags are considered the best choice due to their longer retention time (Rae Baxter, per. comm.).

Estimating Effort

Fishing camps are operated by family units and therefore labor limited. It would seem reasonable to assume that any increase in fishing effort would come from new or currently inactive fishermen entering the fishery. There is the possibility that effort changes throughout the fishing season, but this was not measured during the reporting period. Our observations indicate that fishing effort remained constant since nets were left in the water 24 hours per day. Decrease in catch might occur in late spring after the northern pike have spawned in shallow lakes and are no longer moving through slough areas. Also high water at spring breakup and the subsequent lower flows of late spring early summer may effect catch.

Observations suggest that total fishing effort could be estimated by counting: 1) active fishing camps, 2) drying racks, 3) gillnets set, etc. Aerial observations of the fishery showed that certain fishing related objects are easily seen from the air. Active camps were easily recognizable due to the presence of boats with outboards and smoke from the woodstove. Gillnets were difficult to see even with the addition of orange colored floats. However, once the water conditions had stabilized after breakup gillnets were generally left in one place, so that knowing where nets "should be" made them easier to count. Using a boat to monitor effort was difficult due to the vast area that needs to cover and the fact that new net sets would be found only by chance. Monitoring effort of those fishermen commuting to nets out of the village could be monitored by counting fishing racks or counting nets at their fishing locations.

Estimating Total Harvest

We can measure the contributions of both subsistence and commercial harvest from total harvest by subtracting commercial harvest, which is derived from ADF&G fish ticket information which must be filled out for any commercial sale. A direct count of total subsistence harvest would be difficult without a large labor force and great expense, costing more money than the fishery might ever generate. To estimate subsistence/commercial harvest and effort it is suggested that a method similar to the roving creel survey with nonuniform probability sampling as described by Malvestuto and Davies (1978) may be used. This method is used to survey sport hook and line fisheries, but could be adapted to a subsistence/commercial fishery of the type in Selawik. This method would stratify the fishery into smaller areas making it cost effective to make testable estimates of total harvest and fishing effort. Harvest can be correlated with simple effort estimates, such as number of fish camps or numbers of nets. Combining this information with known estimates of harvest could be used to monitor total harvest.

Monitoring Exploited Stocks

With an estimate of the subsistence/commercial harvest and effort we can observe future changes in the fishery and monitor the exploited stocks. It is suggested that development of catch curves and cohort analysis, as described by Ricker (1975), as well as documenting changes in catch per unit effort and yield in kilograms per hectare of the fishery, would be a simple and effective method to monitor changes or over exploitation in the fishery.

RECOMENDATIONS

1) Develop census techniques to give total subsistence/commercial harvest and effort. It is suggested that a nonuniform probability sampling technique be used.

2) Define whitefish and northern pike stocks.

3) Monitor exploited whitefish and northern pike stocks, and determine the effects of increased pressure on their populations.

4) Find better techniques for ageing whitefish.

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APPENDIX

Table 3.--Age by length of broad whitefish, humpback whitefish, least cisco and northern pike from the Selawik River, 1985.

BROAD WHITEFISH

Age	3	6	7	8	9	10	11	12	13
Mean Length(mm)	240	399	383	414	424	415	429	452	467
Length Range		(398-400)	(341-420)	(362-477)	(367-538)	(329-466)	(394-462)	(414-532)	-
Standard Dev.	-	1	33	35	44	49	34	54	-
n	1	2	4	11	13	6	3	4	1

HUMPBACK WHITEFISH

Age	5	6	7	8	9	10	11	12	13
Mean Length(mm)	313	347	342	363	382	392	401	417	456
Length Range	(224-402)	-	(323-367)	(320-449)	(329-439)	(355-433)	(362-445)	(394-469)	(444-468)
Standard Dev.	126	-	17	36	35	25	30	35	17
n	2	1	7	13	16	10	8	4	2

LEAST CISCO

Age	2	3	4	5	6	7	8	9
Mean Length(mm)	162	246	251	275	321	300	309	337
Length Range	(125-198)	(194-389)	(204-311)	(232-339)	(277-387)	(270-337)	(300-317)	-
Standard Dev.	52	69	40	36	38	33	12	-
n	2	7	7	12	6	5	2	1

NORTHERN PIKE

Age	4	5	6	7	8	10	11	12	13
Mean Length(mm)	430	494	502	521	507	375	479	683	688
Length Range	-	-	(479-534)	(473-577)	(505-508)	-	-	-	-
Standard Dev.	-	-	28	53	2	-	-	-	-
n	1	1	3	3	2	1	1	1	1

Table 4.--Spring subsistence/commercial fishery maximum harvest estimate for 1985 season.

Species	A Net-hrs/ day/ fisherman	B Fisherman-* days/ 1985 season	C Total effort (AxB)	D Catch/hr/ 100' of net	E Mean net length(ft)	F Mean net catch rate $\frac{DxE}{100}$	G Total # harvested (CxF)	H Mean wt (gms)	Total wt Harvested kg(lbs) (GXH)
Broad Whitefish	23	725	16,675	0.838	73	0.662	13,974	984	13,759 (30,800)
Humpback Whitefish	"	"	"	0.369	"	0.292	4,869	864	4,207 (9,424)
Least Cisco	"	"	"	0.044	"	0.035	584	453	265 (594)
Northern Pike	"	"	"	0.694	"	0.548	9,138	2,402	21,949 (49,166)
Sheefish	"	"	"	0.006	"	0.005	83	4,367	363 (813)

* Fisherman-day/season is estimated by 29 fishermen X 25 day season.

Table 5.--Spring subsistence/commercial fishery minimum harvest estimate for 1985 season.

Species	A Net-hrs/ day/ fisherman	B Fisherman-* days/ 1985 season	C Total effort (AxB)	D Catch/hr/ 100' of net	E Mean net length(ft)	F Mean net catch rate $\frac{DxE}{100}$	G Total # harvested (CxF)	H Mean wt (gms)	Total wt Harvested kg(lbs) (GXH)
Broad Whitefish	23	450	10,350	0.838	79	0.662	6,852	984	6,742 (15,102)
Humpback Whitefish	"	"	"	0.369	"	0.292	3,022	864	2,611 (5,848)
Least Cisco	"	"	"	0.044	"	0.035	362	453	164 (367)
Northern Pike	"	"	"	0.694	"	0.548	5,671	2,402	13,621 (30,512)
Sheefish	"	"	"	0.006	"	0.005	52	4,367	227 (509)

* Fisherman-day/season is estimated by 18 fishermen X 25 day season.

Table 6. Summary of fish harvested by subsistence fishers. Sampling took place between June 12 and June 24, 1985, and was gathered from different fisher dates and fisher areas.

Species	Total # of fish caught	Mean # of fish caught-per-hour-per-100' of net	Standard deviation	Length range (mm)	Mean length (mm)	Standard deviation	Weight range (g)	Mean weight (g)	Standard deviation	Combined K, male & female	Standard deviation
BWF	284	0.838	0.878	328-494	427 n=240	28	550-1500	984 n=45	247	1.291 n=45	0.254
HWF	132	0.369	0.477	352-513	405 n=87	33	500-1600	864 n=38	285	1.194 n=38	0.135
LCI	13	0.044	0.078	292-381	330 n=11	26	300-800	453 n=11	143	1.227 n=11	0.135
NOP	269	0.694	0.568	420-1020	650 n=130	106	475-7500	2402 n=71	1438	0.709 n=71	0.207

* Broad whitefish (BWF), humpback whitefish (HWF), least cisco (LCI), and northern pike (NOP).

Table 7.--Length/weight regressions of fish species harvested in the subsistence fishery.

BWF*	n = 285	$\log_{10}$ weight (gms) = -3.1 + 2.3 $\log_{10}$ fork length (mm)
HWF*	n = 132	$\log_{10}$ weight (gms) = -4.1 = 2.7 $\log_{10}$ fork length (mm)
LCI*	n = 13	$\log_{10}$ weight (gms) = -1.4 + 1.6 $\log_{10}$ fork length (mm)
NOP*	n = 269	$\log_{10}$ weight (gms) = -4.8 + 2.9 $\log_{10}$ fork length (mm)
SF*	n = 3	$\log_{10}$ weight (gms) = 3.34 + 0.01 $\log_{10}$ fork length (mm)

* Broad whitefish (BWF), humpback whitefish (HWF), least cisco (LCI), northern pike (NOP), and sheefish (SF).

Table 8.--Condition factor (K) of broad whitefish (BWF), humpback whitefish (HWF), least cisco (LCI), and northern pike (NOP) from the Selawik River drainage, 1985.

Species	K	Standard Deviation	n	Length Range (mm)	Weight Range (gms)
BWF	1.478	0.333	44	250 - 538	185 - 2,600
HWF	1.216	0.185	63	224 - 469	102 - 1,450
LCI	1.114	0.223	42	125 - 389	16 - 800
NOP*	0.709	0.207	71	420 - 1,020	475 - 7,500

* All northern pike were sampled from the subsistence/commercial fishery.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Selawik National Wildlife Refuge
Box 270
Kotzebue, AK 99752

IN REPLY REFER TO:

NOTICE TO FISHERMEN!

Be on the lookout for tagged WHITEFISH!

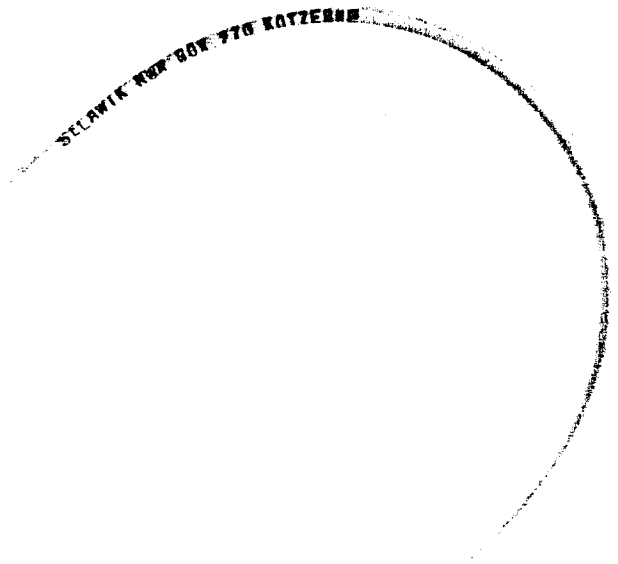
During the Fall of 1985, whitefish will be tagged with yellow tags on the upper Selawik River as part of an ongoing whitefish study being conducted by the Selawik NWR. If you catch a tagged fish, please return the tag in one of the envelopes provided, fill out the enclosed questionaire, and mail it to Salawik NWR, Box 270, Kotzebue, AK 99752.

Your help is important in helping us understand the life histories of the whitefish utilized by the people of Selawik and is greatly appreciated.

Sincerely,

Rich Johnson

Rich Johnson
U.S. Fish and Wildlife Service



Tag Return Questionaire

Please fill out the enclosed questionaire and, along with the tag, send it to the following address in the envelope provided: Selawik NWR, PO Box 270, Kotzebue, Ak 99752. No postage is necessary.

Name of the fishermen:

_____

When was the tagged fish caught?

_____

Where (approximately) was the fish caught?

_____
_____
_____
_____
_____
_____

How was the fish caught? Under the ice? Gillnet? Seine? etc.

_____
_____
_____
_____
_____
_____